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Efficiency of Some Insecticides Alone and Mixed with Mineral Oil KZ on Cotton Mealybugs, *Phenacoccus solenopsis* (Tinsley) Hemiptera: Pseudococcidae

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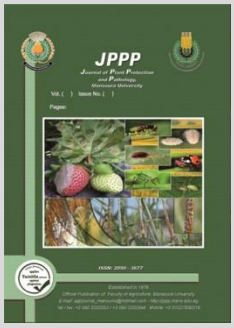

ABSTRACT

Cotton mealybugs, *Phenacoccus solenopsis*, (Tinsley) Hemiptera: Pseudococcidae, caused major loss in economic crops at over the world. This study was conducted to test and evaluate effect of some insecticide classes on the cotton mealybugs *P. solenopsis*, in the field condition on Jews mallow, *Corchorus olitorius*, L., and okra, *Abelmoschus esculentus*, L., on Nage Hamade, Egypt. This treatment was Actellic 50 %EC , KZ oil 95% EC (mineral oil), Actellic 50 %EC + KZ oil , *Beauveria bassiana* (Biothiana), Biothiana + KZ oil (0,75L/ 100L), Biothiana+ KZ oil (0,375L/ 100L), *Metarhizium anisopliae* (Biometa), Biometa+ KZ oil (0,75L/ 100L) and Biometa+ KZ oil (0,375L/ 100L). All treatment had high effective on nymph than adult. This date showed that high effect was recorded by Actellic 50 %EC + KZ oil on both crop. Biothiana had high effect than Biometa in case used solitary or mixed with KZ oil. Statically analysis shows that the high effect was recorded by Actellic 50 %EC + KZ oil followed by Actellic 50 %EC , bioinsecticides mixed with KZ oil, bioinsecticides solitary and finally KZ oil only.

Keywords: *Phenacoccus solenopsis*, Mineral oil, Actellic 50 %EC, KZ oil 95% EC, *Beauveria bassiana*, Cotton mealybug

INTRODUCTION

In India cotton mealybug *Phenacoccus solenopsis*, (Tinsley), Hemiptera, Pseudococcidae, was recorded on about 194 plant hosts, including the field crops; fruit plants; vegetables; ornamentals; cottons and others at over the world essentially in the tropical regions, Vennila *et al*. (2011). Major of farmers strongly dependent on insecticide because it an effective and easy way to control like this pests. The feeding damages dependent on yields potential and usually specify through the symptoms, e.g. stunting, damage or loss in fruiting periods and death of plants in some cases, Khan *et al*. (2013).

Nagrare *et al.*, (2016), researched on "nineteen" formulations of insecticides belonging to "10" insecticide groups, to evaluate the toxicity on the "cotton mealybug" *P. solenopsis*, and reported that, the pesticide, "Thiodicarb" appear high effect on *P. solenopsis*, and safer moderately against *A. bambawalei*, and can be judicious use to against *P. solenopsis*, which have the lower harmful to the environments.

Abd El-Mageed *et al.*, (2018), mentioned that the "Chlorpyrifos" in the field experiment was highly significant in population reduction of "cotton mealybug" *P. solenopsis*, and the "Imidacloprid" was in second rank, followed by "Pyriproxyfen; Emamectin benzoate and Buprofezin" respectively, with the reduction average ranged between (96.24 - 43.99%). The toxicants (IGRs) Buprofezin and Pyriproxyfen appear more toxic to insect predacious than others.

Also, (Rizk *et al.*, 2019) studied 7 pesticides belonging to different chemical groups; "Sulfoxaflor; Abamectin + Thiamethoxam; Spirotetramat; Thiamethoxam; Imidacloprid; Buprofezin and Pymetrozine", in the field conditions on nymphal stars and female adults of *P. solenopsis*, on potato plants at Beheria gov., Egypt., and the data concluded that, the "Sulfoxaflor; abamectin+Thiamethoxam and Spirotetramat" appear highly effective to *P. solenopsis*, with field population reductions ranged about (80.3 to 96.05%) throughout (21 days) from treatments. The pesticides "Thiamethoxam; Imidacloprid; Buprofezin and Pymetrozine, they failed to control and obstruction of *P. solenopsis*, on potato plants.

The current study aim to evaluation effect for some chemical pesticides belonging to different classes to controlling of "cotton mealybug" *P. solenopsis*, in the field conditions, on Jews mallow and okra crops on Nage Hamade, Egypt.

MATERIALS AND METHODS

The tested pesticides and mineral oil they are as follow:

1. Actellic 50 %EC (pirimphos-methyl) : tested at rates 200 cm/100L
2. KZ oil 95% EC (mineral oil). It is a mineral oil, recommended for controlling scale insects at 1.5L/ 100L, produced by Kufrel-Zayaat Co. for Pesticides and Chemical, Kufrel- Zayaat, Egypt.
3. Actellic 50 %EC (200 cm/100L) + KZ oil 95% (1.5L/ 100L)
4. *Beauveria bassiana* (Biothiana) WP2.5% 250g/100L.
5. *Beauveria bassiana* (Biothiana) WP2.5% 250g/100L+ KZ oil 95% (0,75L/ 100L)
6. *Beauveria bassiana* (Biothiana) WP2.5% 250g/100L+ KZ oil 95% (0,375 L/ 100L)

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7. *Metarhizium anisopliae* (Biometa) WP2.5% 250g/100L.
8. *Metarhizium anisopliae* (Biometa) WP2.5% 250g/100L + KZ oil 95% (0,75L/ 100L)
9. *Metarhizium anisopliae* (Biometa) WP2.5% 250g/100L + KZ oil 95% (0,375L/ 100L).

The field evaluations of the tested insecticides, on *P. solenopsis*, field experiments were conducted in summer season (2020) to test the effect of "nine" insecticides treated on "Jews mallow" *Corchorus olitorius*, L., and "okra crop, *Abelmoschus esculentus* L., in field condition at Nage Hamade, Egypt. Experiments were laid out in a randomized blocks designs with "nine" treatments. Each treatment was replicated three times (42m^2 each/per plot). Mineral oils and insecticides were sprayed by using a hand-laboratory sprayer equipped with nozzle flat-fan capacity 2-litters. Mealybugs, on the top (10 inches) of a plants terminal portion were estimated including stems and leaves. When the sufficient numbers of mealybug populations were observed in experimental blocks, the treatments, it became an urgent necessity. The observation was record a day before spray and one; three; seven and 14 days after spray treatments. On the other hand, reductions percentages in population of mealybug ceased by the different treatments were calculated according to equation "(Henderson and Tilton 1955).

% Reduction Percentage =100 {1-(Cb/Ca XTa/Tb)}

Where:

Ta = No of a live individuals after treatment application on treated trees.
Tb= No of a live individuals before treatment application on treated trees.
Ca = No of a live individuals after treatment application on control trees.
Cb= No of a live individuals before treatment application on control trees.

Statistical analysis.

Obtained data was analyzed as (one way or factorial), using Proc. ANOVA in SAS program (Anonymous. 2003). The "Means" were compared by "Turkey's HSD" (*P*=0.05) level in same program.

RESULTS AND DISCUSSION

Insecticide efficacy against the nymph and adult female of the cotton mealybug

The insecticide efficacy of nine compounds from different chemical groups, applied as foliar treatment against the cotton mealybug *P. solenopsis*, was evaluated under field conditions. Data presented in Tables 1 and 2 summarized the effects of the evaluated insecticides, used separately, in suppressing the nymph, adult female and total populations of *P. solenopsis* on Jew's mallow *Corchorus olitorius* L. and okra *Abelmoschus esculentus* L. plants during summer seasons on Nage Hamade, Egypt, 2020. The mealybug populations per Jew's mallow and okra plants were not the same before application of the tested insecticides. In fact, this is a common problem where the crop is grown under field conditions and infested plants are randomly chosen and sampled (Hanchinal *et al.* 2009; Ahmad *et al*. 2011*).* Hence, the formula of Henderson and Tilton (1955) was used to calculate the percentage of mealybug population reduction using the mean population pre and post spraying in treated and untreated controls. It is obvious that **Actellic 50 %EC** and Actellic 50 %EC + KZ oil induced a fast, initial effect after 1 day of application against adult, nymphs and total population (76.36 %, 85.06% and 81.51% &81.51%, 88.00% and 85.39%) and (60.64 %, 88.60% and 75.29% &94.70%, 91.62% and 93.09%) on Jew's mallow and okra, respectively (Tables 1 and 2).

Table 1. Efficacy of different insecticides against *P. solenopsis* population on Jew's mallow under field conditions

Treatment	1 day after treatment			3 days after treatment			7 days after treatment			14 days after treatment		
	Adult	Nymph	Total	Adult	Nymph	Total	Adult	Nymph	Total	Adult	Nymph	Total
KZ oil	58.15	70.61	64.90 d	73.96	72.35	72.64 ed	74.00	76.38	75.23 e	39.18	70.77	58.14 d
Actellic	76.36	85.06	81.51 b	93.18	91.92	92.50 ab	92.11	94.15	93.34 ab	82.56	89.68	86.98 bc
Actellic + KZ oil	81.51	88.00	85.39 a	93.28	94.28	93.91 a	92.67	94.72	93.90 a	86.09	92.06	89.85 a
Biometa	62.91	67.85	65.45 d	58.60	69.92	64.49 f	85.94	87.62	86.89 cd	84.25	86.21	85.39 c
Biometa + 50% KZ oil	71.82	75.11	73.57 c	68.53	76.28	72.73 de	87.87	93.04	90.74 abc	85.65	91.59	89.06 abc
Biometa + 25% KZ oil	67.94	75.50	71.98 cd	64.90	77.41	71.48 ef	85.66	92.60	89.40 bcd	85.52	87.88	86.97 bc
Biothiana	62.82	65.41	64.29 d	88.48	73.51	80.35 cd	83.93	86.55	85.40 d	81.66	85.12	83.52 c
Biothiana + 50% KZ oil	79.71	69.81	74.46 bc	84.32	87.26	85.86 bc	81.24	89.69	86.29 cd	77.21	87.65	83.53 c
Biothiana + 25% KZ oil	72.04	76.09	74.03 bc	82.88	87.85	85.33 bc	90.34	94.94	92.78 ab	90.95	91.57	91.33 ab
HSD			7.94			4.96			4.96			5.72
F			19.25			35.36			40.49			27.45
P			0.0001			0.0001			0.0001			0.0001

Values at each Colum have same letters are not significantly different (Tukey's HSD, P< 0.05).

Table 2. Efficacy of different insecticides against *P. solenopsis* population on okra under field conditions

Treatment	1 day after treatment			3 days after treatment			7 days after treatment			14 days after treatment		
	Adult	Nymph	Total	Adult	Nymph	Total	Adult	Nymph	Total	Adult	Nymph	Total
KZ oil	28.91	76.76	55.31 d	40.55	80.26	63.36 c	52.66	81.22	69.14 d	75.10	81.70	78.74 c
Actellic	60.64	88.60	75.29 b	92.40	92.38	92.34 a	89.02	91.74	90.49 ab	87.24	91.17	89.34 ab
Actellic + KZ oil	94.70	91.62	93.09 a	95.29	96.23	95.80 a	93.81	94.81	94.35 a	91.06	93.20	92.29 a
Biometa	44.06	75.56	61.93 cd	60.15	87.85	76.46 b	68.60	89.44	80.77 c	70.99	81.08	76.72 c
Biometa + 50% KZ oil	61.65	80.10	71.49 bc	65.17	89.37	78.60 b	75.84	93.78	85.87 bc	80.15	84.63	82.53 bc
Biometa + 25% KZ oil	59.11	80.25	70.37 bc	63.86	86.11	76.20 b	73.32	93.14	84.30 bc	80.47	84.53	82.61 bc
Biothiana	49.72	76.14	64.09 cd	64.34	88.09	77.85 b	72.02	89.72	81.99 c	75.10	81.67	78.64 c
Biothiana + 50% KZ oil	61.27	79.66	70.98 bc	64.99	93.36	80.68 b	75.84	93.56	85.68 bc	79.71	84.08	82.06 bc
Biothiana + 25% KZ oil	61.44	81.50	72.17 bc	65.92	92.67	80.74 b	74.81	93.51	85.15 bc	80.01	84.89	82.62 bc
HSD			4.96			4.96			4.96			4.96
F			22.63			72.17			5.64			35.75
P			0.0001			0.0001			0.0011			0.0001

Values at each Colum have same letters are not significantly different (Tukey's HSD, P< 0.05).

After that on third day the reduction percentage increased gradually to record highly reduction percentage at seven day after treatment by Actellic 50 %EC + KZ oil against adult, nymphs and total population (92.67%, 94.72% and 93.90% &93.81%, 94.81% and 94.35%) respectively, on Jew's mallow and okra (Tables 1 and 2).

The reduction in total population was increased to record highly reduction at 7 day after treatment then decreased. The treatment with Actellic + KZ oil recorded highly reduction for total population *P. solenopsis* 93.90% and 94.35% on Jew's mallow and okra, respectively. While Biometa and Biothiana at first day 65.45% & 64.29% and 61.93%&64.09% on Jew's mallow and okra, respectively. After that the reduction increased gradually to high effective at 7day and 14 day of treatment. The mixed treatment Biometa + 50% KZ oil and Biometa + 25% KZ oil increased to shows that 85.65% &85.52% and 85.87%& 84.30% on Jew's mallow and okra, respectively (Table1-2).

While, after fourteen day treatment the reduction percentage decreased in case of Actellic 50 %EC + KZ oil record on total population of *P. solenopsis* (89.85% and 92.29%) on Jew's mallow and okra (Tables 1 and 2). Also, bioinsecticides solitary or mixed with KZ oil decreased but with less value than chemical insecticides solitary or mixed with KZ oil.

Statically analysis assured that the high effect was recorded by Actellic 50 %EC + KZ oil followed by Actellic 50 %EC , bioinsecticides mixed with KZ oil, bioinsecticides solitary and finally KZ oil only.

Metarhizium anisopliae strain PRL 526 is effective against cotton mealybug this reported by Ujjan *et al.* (2015). Rezk *et al* (2019) study seven insecticides *viz.* sulfoxaflor, abamectin + thiamethoxam, spirotetramat, thiamethoxam, imidacloprid, buprofezin, and pymetrozine, belonging to different chemical groups, were tested for their effect against nymphs and adult females of *P. solenopsis* on potato under field conditions. They found that sulfoxaflor, abamectin + thiamethoxam and spirotetramat had recording 80.3–96.05% reduction of the insect population after 21 days of application against *P. solenopsis.* While, Thiamethoxam, imidacloprid, buprofezin and pymetrozine failed to exhibit sufficient *P. solenopsis* c

Data presented in Figure 1 (a and b), cleared that, the effects of different insecticides on the mean population percent reduction of adult, nymphs and total population on Jew's mallow and okra. All treatment had high effective on nymph than adult. This date show that high effect was recorded by Actellic 50 %EC + KZ oil on both crop. Biothiana had high effect than Biometa in case uses solitary or mixed with KZ oil. This results agree with, Abozeid (2017) studied that evaluation the efficiency of mixing some oils with entomopathogenic fungus *Beauveria bassiana* against *Aphis craccivora* and find that oil formulations (horticulture /mineral oils) are one of the most promising technologies for enhancing efficacy of the entomopathogenic *B. bassiana* against aphids. mixing orange oil with *B. bassiana* has exerted a considerable mortality percentage against *A. craccivora.*

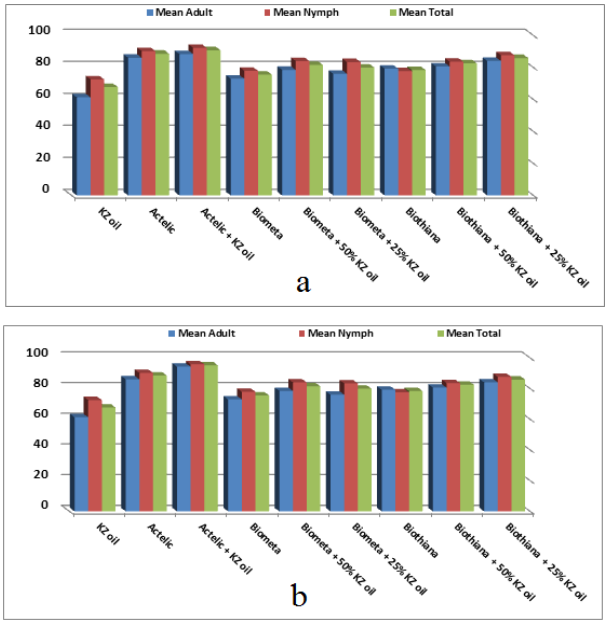

Figure 1. Mean reduction different insecticides against *P. solenopsis* population on Jew's mallow (a) and okra (b) under field conditions

Also, Our results are in complete agreement with the previous studies which demonstrated the improved insecticidal efficacy of different oil formulation from entomopathogenic fungi against some pests (Osborne & Landa, 1992; Malsam *et al*., 2002; and Wraight *et al*., 2016).

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فاعلية بعض المبيدات الحشرية وحدها والمخلوطة بالزيت المعدني KZ ضد بق القطن الدقيقي *Phenacoccus solenopsis* Tinsley (Hemiptera: Pseudococcidae)

حسام محمد حارس

معهد بحوث وقاية النباتات – مركز البحوث الزراعية – الدقى – جيزة – مصر

يتسبب بق القطن الدقيقي ، *Phenacoccus solenopsis* Tinsley (Hemiptera: Pseudococcidae) في خسائر في العديد من المحاصيل الاقتصادية المهمة. قيمت هذه الدراسة كفاءة بعض المبيدات الحشرية المختلفة ضد بق القطن الدقيقي *P. solenopsis* تحت الظروف الحقلية على الملوخية *Corchorus olitorius* L والبامية *Abelmoschus esculentus* L في نجع حمادى ، مصر. كانت هذا المعاملات هي (Actellic 50 %EC , KZ oil 95% EC (mineral oil), Actellic 50 %EC + KZ oil , *Beauveria bassiana* (Biothiana), Biothiana + KZ oil (0,75L/ 100L), Biothiana+ KZ oil (0,375L/ 100L), *Metarhizium anisopliae* (Biometa), Biometa+ KZ oil (0,75L/ 100L) and Biometa+ KZ oil (0,375L/ 100L). كانت جميع المعاملات ذات فعالية عالية على طور الحورية مقارنة بالإناث البالغه. توضح هذه الدراسة أنه تم تسجيل تأثير عالي بواسطة زيت Actellic 50٪ EC + KZ على كلا المحصولين بينما Biothiana كان له تأثير أعلى من Biometa في حالة استخدامه منفردًا أو ممزوجًا بزيت KZ. يظهر التحليل الإحصائي أن التأثير العالي سجل بواسطة زيت Actellic 50٪ EC + KZ يليه Actellic 50٪ EC ، المبيدات الحيوية الممزوجة بزيت KZ ، المبيدات الحيوية المنفردة وأخيراً زيت KZ فقط.